Estimation of Groundwater Quality and its Suitability for drinking use in Beemanapally Watershed Telangana, India

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Abstract- **In the administration of water assets, quality of water is as important as its amount. Disintegration of groundwater quality due to the anthropogenic exercises is expanding at a disturbing rate in many parts of Nalgonda. Yet the information related to the groundwater quality and other physiochemical parameters is still limited. This report features the analysis of groundwater quality and its suitability for drinking purposes in the study area. With a specific end goal to know the quality and appropriateness of groundwater for local and water system in study area, water samples from 60 different locations were collected and tested for various parameters. These samples were analyzed for significant pH, electrical conductivity, total dissolved solids, calcium, magnesium, sodium, potassium, bicarbonate, carbonate, sulfate, chloride, nitrate, fluoride and various other physicochemical parameters. From the aforementioned results, it can be clarified that most of water quality variables exceeded the limits specified by the standards for drinking water. The results of this study will be helpful in designing an effective strategy to utilize the ground water for drinking purpose.**

Index Terms- Groundwater, Geologic Formation, Water quality, Rangareddy District, Telangana.

INTRODUCTION

Water is the essence of life. It is the basic requirement for one's survival and access to clean potable water is an essential human right that can't be denied to anyone. With increasing population, industrialization and globalization, the demand for water is an all-time high. It's day by day increase in demand is putting a great stress on the water resources around the world. The uneven distribution of water across time (temporal) and space (spatial) as well as the increased consumption and usage along with the problems of pollution, contamination, misuse and wastage; have given rise to water crisis in different parts of the world. Even though, three-fourth of earth's surface is covered with water, yet daily needs of the entire population across the worldis not less than a mammoth challenge. This is because out of this enormous volume of water, only a small proportion, i.e., 2.5% of the total volume is constituted by fresh water. Further around 68.9% of this fresh water is in the form of ice and snow, 29.9% is present as ground water, 0.3% is in the form of lakes and rivers and 0.9% in soil moisture, swamp water and permafrost atmo-sphere leaving us with a very small amount of water that may be used for fulfilling the daily needs of the people (Water and related statistics, 2013). The main objective of the article is to determine the groundwater quality for drinking and compared the chemical analysis data of the groundwater with the water quality standards.

STUDY AREA

Telangana is the 29th state of India, the state has an area of 1,12,077 Sq. Km. and has a population of 3,50,03,674. The Telangana region was part of the Hyderabad state from Sept 17th 1948 to Nov 1st 1956, until it was merged with Andhra state to form the Andhra Pradesh state. Telangana is surrounded by Maharashtra and Chhattisgarh in the North, Karnataka in the West and Andhra Pradesh in the South and East directions. Major cities of the state include Hyderabad, Warangal, Nizamabad and Karimnagar. The Beemanapally sub basin is the tributary of Krishna river. The research areas are covering the parts of South Eastern Portion of Rangareddy and south western portion of Nalgonda

Districts of Telangana state. The study area lies between 16040′-16060′N latitude and 78030′-78050′E longitude. In addition, the total study area is about 55.87sq.km. It is falls in the SOI Toposheet No. 56 L, 56 P/2, 56 L/5, 56 L/9,56L/10, 56/ L/13 and 56L/14 and it covers 60 villages, and few hamlets of Rangareddy and Nalgonda districts FIGURE (1)

GEOLOGY AND HYDROLOGY

The area forms a segment of the Central part of the peninsular shield of South India. The Archaean Gneissic complex, Precambrian rocks, Characterize it. Large tracts of granite migmatite gneiss with supra crystal enclaves, dominantly occur in the area. The rocks exhibit imprints of polyphase deformation and metamorphism. The granitoids range in composition from tonalite – tandjhemite to granodiorite, alkalifeldspar granite and quartzite, they exhibit typical granite landforms such as inselbergs, tors, domes, hills, and rocky knobs. The occurrence of ground water is determined by the geology; the distribution of water in the ground depends on the nature of rock formations. The area under investigation forms a parts of the Precambrian peninsular shield, and the rocks are referred to as the basement complex or the peninsular gneissic complex which is formed about 2800 million years' age.In the study area Archaean age Dharwar supper group granites rocks are covering the 90% of the area. In addition, a continue chain of lower Proterozoic Dolerite dykes are passing through study area covering Madgul, Irwin and Sirsangadla villages in the direction of north to south. Where as in northeast boundary of the study area near Maisigandi village Archaean age Amphibolite rocks are notified FIGURE (2) Intrusives of dolerite dykes are common in the study area and These geological units have undergone continue weathering. Based on the available data and field enquiries the length of casing pipes used in the borewells are considered to be the weathered thickness at various locations. The analysis of data reveals that the weathering depth ranges from 3.0 to 24.4 m,bgl, the weathered zone and the secondary porosity facilitate groundwater recharge at some places. The study area covered with alluvial fills and dissected plateau having high recharge values. Groundwater occurs in all the geological formation, it is in phreatic condition in alluvium and weathered crystalline and in semi confined to confined condition in the deep fractured rocks. Based on Hydrogeological information the study area can be divided into two units Valley fills and Crystallines. Valley fills are noticed along the valley portion and along the streams. Rainfall is the main source of groundwater recharge in the area. Topographic survey was carried out at 60 locations with grid pattern for more precise measurement of surface elevation using advance Differential Global Positioning System (DGPS) surveying technology. This instrument (Trimble R3 GPS) is equipped with a GPS receiver, antenna and rugged handheld controller. The 25 Trimble R3 systems bring precise sub centimetre control of elevation which has been reduced to the mean sea level FIGURE (3).

MATERIALS AND METHODS

Groundwater tests were gathered from 60 areas in the Beemanapally Watershed FIGURE (4). The gathered water samples were moved into pre-cleaned polythene holder for further investi-gation. Samples were investigated in the research center for variousphysico-substance qualities like pH, electrical conductivity (EC), total hard-ness (TH), total dissolved solids (TDS), dissolved silica and significant ions (Ca^{2+}, Mg^{2+}, Na^+, K^+, Cl, CO_3, $HCO_3$and SO_4^{2-}). All parameters were studied by following standard techniques as described earlier (Toumi et al., 2015). The pH and conductivity were measured by utilizing Systronics smaller scale pH meter, model 361 and Deluxe conductivity meter display 601. Total Hardness (TH), Ca^{2+}, Mg^{2+}, Cl, $CO_3$and HCO_3were dic-tated by titration. Na^+ and K^+, were measured by Flame photometry, SO_4^{2-} by Lovibond spectrophotometer.

RESULTS AND DISCUSSION

The detailed results of the chemical parameters for the collected groundwater samples has been shown in Table 1, where the groundwater variables were compared with prescribed regional and international guidelines for drinking water. There were a large significant differences found in the studied variables observed in the groundwater among various different sites. The pH value of water is an important indicator of the acidic-basic interaction of organic components of water and a number of minerals. The pH value of groundwater samples indicated their slightly acidic to alkaline nature (pH ranged from 7.08 to 9.49 in pre mon-soon season as shown in FIGURE (5a)while during post moon soon season it varies from 7.43 to 8.99 as shown in FIGURE (5b).The salinity behavior of groundwater was investigated by analyzing the total dissolved solids (TDS), where the water with TDS >500 mg/L is undesirable for drinking water supplies (WHO, 2008). TDS ranged from 301.44 to 2553.6 in pre mon-soon season as shown in FIGURE (6a)while during post moon soon season it varies from 256 to 2419.2 as shown in FIGURE (6b). The electrical conductivity (EC) in water is based on the function of dissolved mineral matter content; if TDS is high then EC will be high as well. The major anions abundance order in groundwater was Cl> SO24> HCO3, respectively. The concentration of bicarbonate and carbonate in groundwater was may be due to the dissolution of carbonic acid and carbonate weathering in the aquifers (Kumar et al., 2009; Ramkumar et al., 2013).

The content of Mg is comparatively less than that of Ca. The magnesium concentration in groundwater was found to vary from 0 to 155.5 mg/l and 4.9 to 175mg/l in pre and post monsoon seasons respectively. The very high concentration of magnesium value is observed in the study area. This indicates influence of anthropogenic activity on groundwater quality. The high concentration of Mg2+ value more than 30mg/l can lead to a disease called encephalitis FIGURE (8ab)

Fluorideand Bicarbonate

The concentration of fluoride in pre and post monsoon samples ranges from 0.25 to 4.63mg/l and 0.28-5.57mgl respectively. Slightly Decreasing trend is observed in post monsoon samples from pre monsoon samples and observation fluoride values are crossing the WHO limits in pre and post monsoon seasons FIGURE (9ab).

The-carbonate and bicarbonates contribute to all the alkalinity or acid neutralizing power of water. The surface water bodies are rich in bicarbonates compared to groundwater. Bicarbonate rich groundwater shows the aquifer is directly recharged by the surface water. The carbonates are absent in waters with the pH values less than 8.3. The Bicarbonate in groundwater is found to vary from 76-852mg/l and 102-817 mg/l in pre and post monsoons respectively FIGURE (10ab).

The present study will further help to understand the role of natural factors as well as activities related to manmade actions which could affect the quality of ground water. This study will also help to design an efficient strategy to utilize the ground water efficiently, for drinking purposes in the study area.

CONCLUSIONS

The analysis of water quality is being done by collecting 17 samples from various areas of Kangra district of Himachal Pradesh (India). The result shows that pH value of groundwater samples indicated their slightly acidic to alkaline nature (pH ranged from 7.08 to 9.49 in pre mon-soon season while during post moon soon season it varies from 7.43 to 8.99. It also fell within the desirable limits cited by U.S. Environmental Protection Agency (EPA) (2012). The salinity behavior of groundwater was indicated by total dissolved solids (TDS), where the water with TDS > 500 mg/L is undesirable for drinking water supplies (WHO, 2008). The electrical conductivity (EC) in water is based on the function of dissolved mineral matter content; if TDS is high then EC will be high as well. The entire analyzed data is plotted in a graph showing the behavior of samples whether they are in the desired limits are exceeding and its observed that pre monsoon samples are exceeding the limits then the post monsoon

From the aforementioned results, it can be clarified that most of water quality variables exceeded the limits specified by the regional and international standards for drinking water.

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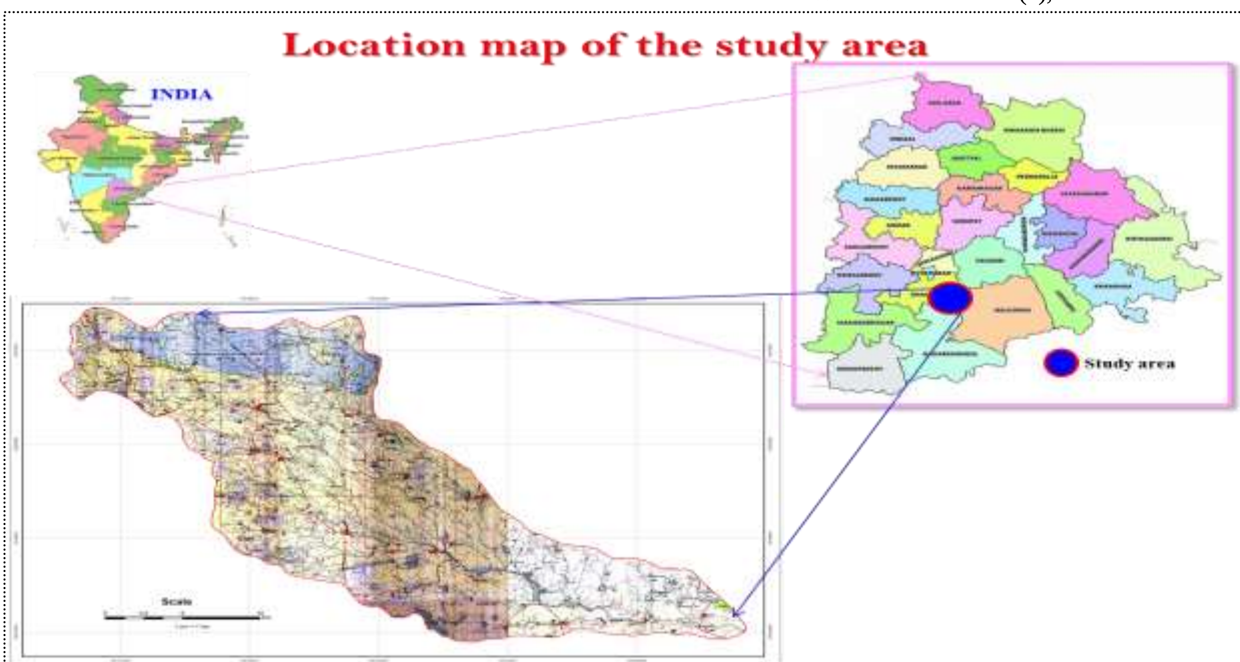

Figure 1 Location map of the Beemanapally sub basin study area

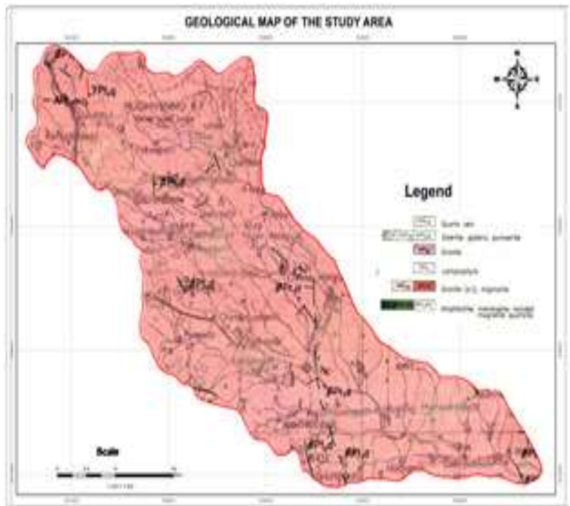

Figure 2 Geology map of study area.

Figure 3 Study area Elevation contour.

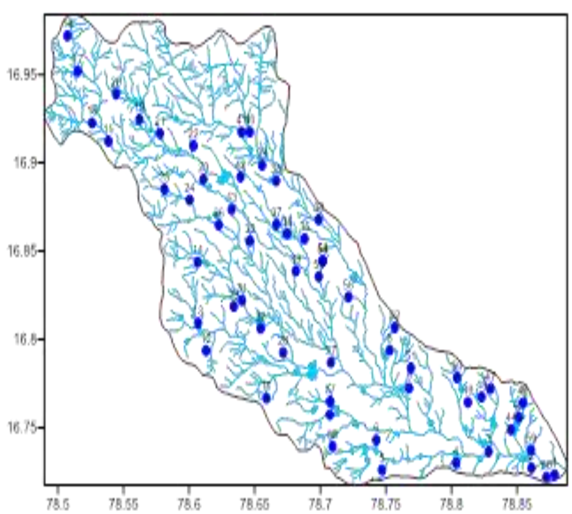

Figure 4 study area well inventory map

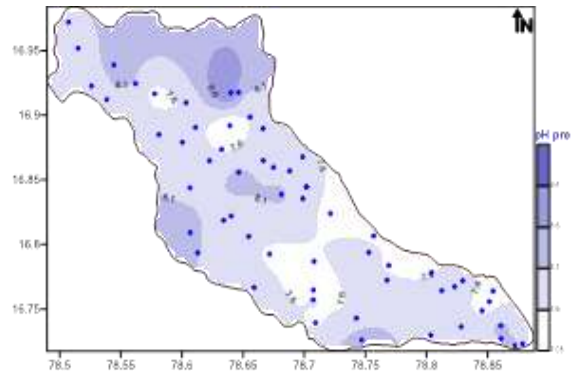

Figure 5a spatial map of pH in Pre monsoon

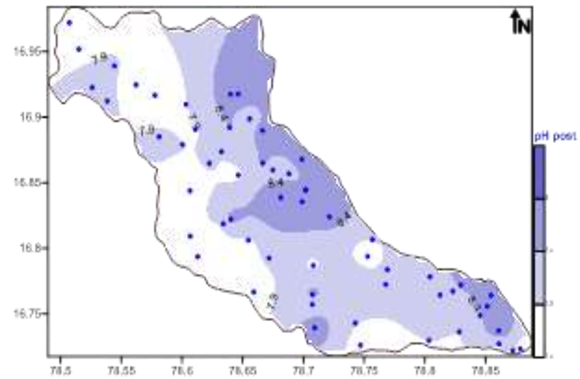

Figure 5b spatial map of pH in post monsoon

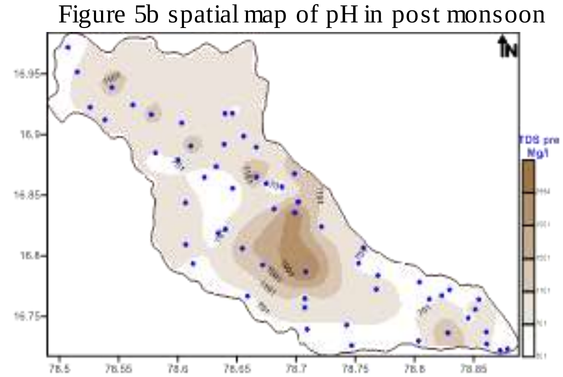

Figure: 6a Spatial map of TDS in Pre monsoon

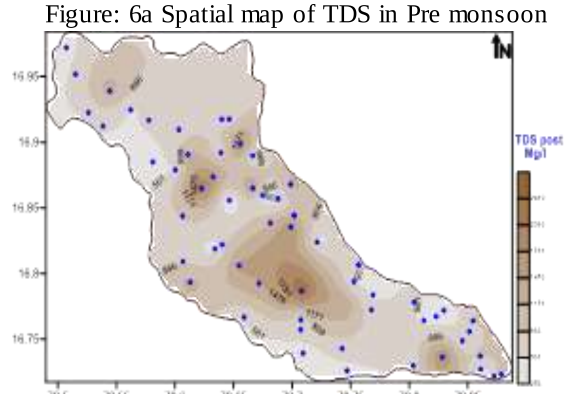

Figure 6b Spatial map of TDS in post monsoon

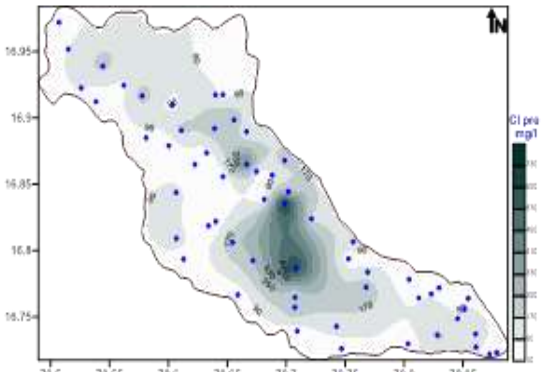
Figure 7 a spatial map of Chloride in Pre monsoon

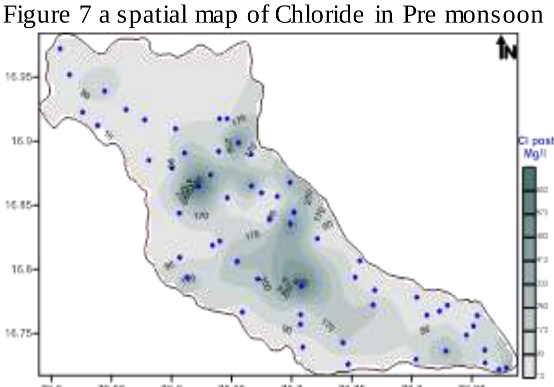
Figure 7b spatial map of Chloride in post monsoon

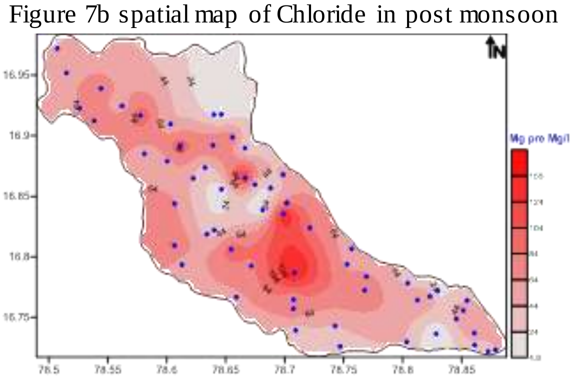
Figure 8a spatial map of in Magnesium in Pre monsoon

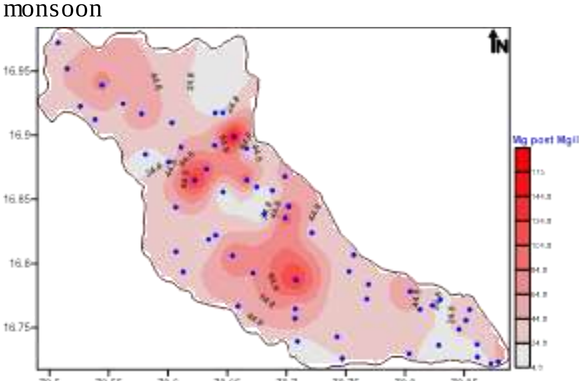
Figure 8b Spatial map of Magnesium post Pre monsoon

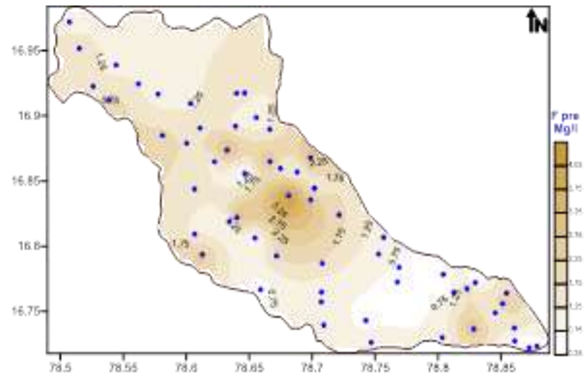
Figure 9 a spatial map of Fluoride in monsoon.

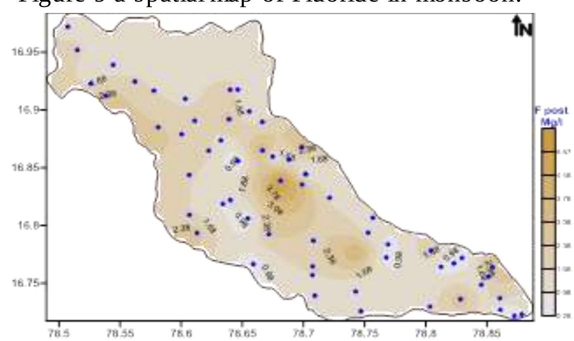
Figure 9b spatial map of Fluoride in Post Pre monsoon

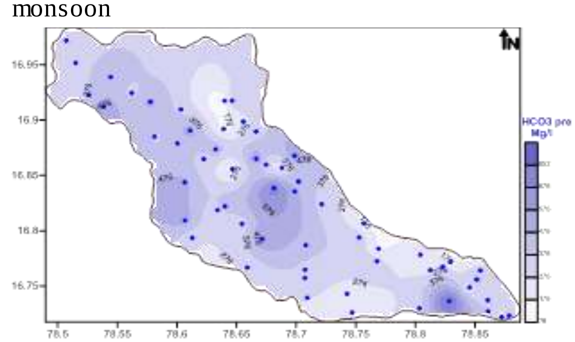
Figure 10a Spatial map of Bi-Carbonate in Pre monsoon

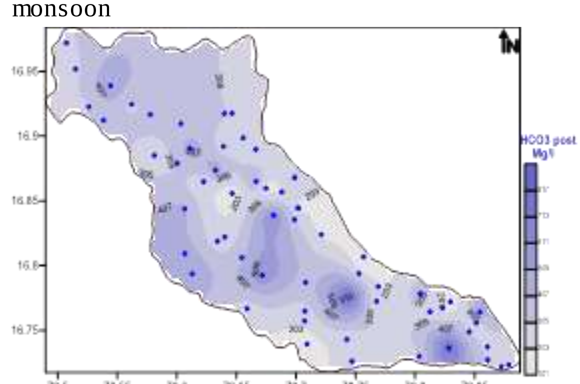
Figure 10b Spatial map of Bi-Carbonate in post monsoon

TABLES

Table 1 Groundwater Suitability for drinking purpose in pre monsoon and post monsoon

Sl. No	Parameter	Standard limits		% of samples in Pre monsoon			% of samples in Post monsoon		
		Permissible	Maximum Accepted	Permissible	Maximum Accepted	Not suitable	Permissible	Maximum Accepted	Not suitable
1	TH	300	600	36.6	55	8.4	55	36.6	8.33
2	pH	6.5-8.5	9.2	96.66	3.33	0	78.3	21.6	0
3	TDS	500	2000	11.8	84.7	3.3	21.6	75	3.3
5	Na	50	-	18.33	0	81.6	25	0	75
6	K	10	-	85	0	15	73.3	0	26.6
7	Mg	30	100	16.6	71.6	8.33	43.3	48.3	8.3
8	Ca	75	200	86.6	13.3	0	73.3	25	1.6
10	F	1	1.5	33.3	35	30	25	21.6	53.3
11	Cl	250	1000	90	10	0	81.6	18.3	0
12	SO4	200	400	96.6	3.33	0	96.6	3.3	0
13	HCO3	30	-	0	0	100	0	0	100
14	CO3	75	200	-	-	-	86.6	13.3	0
15	NO3	45	-	96.6	0	3.3	93.3	0	6.6